

is from Attu, at the western side of the chain, to Atka, and that, so far as he has been able to discover, it does not extend further east.

Observations on Bees and Wasps. By Sir JOHN LUBBOCK, Bart., F.R.S., M.P., F.L.S., Vice-Chancellor of the University of London.

[Read March 19, 1874.]

THE Social Hymenoptera, according to Messrs. Kirby and Spence*, “have the means of communicating to each other information of various occurrences, and use a kind of language which is mutually understood and is not confined merely to giving intelligence of the approach or absence of danger; it is also co-extensive with all their other occasions for communicating their ideas to each other.”

Huber assures us as regards Ants † that he has “frequently seen the antennæ used on the field of battle to intimate approaching danger, and to ascertain their own party when mingled with the enemy; they are also employed in the interior of the ant-hill to warn their companions of the presence of the sun, so favourable to the development of the larvæ, in their excursions and emigrating to indicate their route, in their recruitings to determine the time of departure,” &c. Elsewhere also he says ‡ “that should an Ant fall in with any of her associates from the nest they put her in the right way by the contact of their antennæ.”

These statements are most interesting; and it is much to be regretted that he has not given us in detail the evidence on which they rest. In another passage, indeed, he himself says § “if they have a language, I cannot give too many proofs of it.” Unfortunately, however, the chapter which he devotes to this important subject is very short, and occupied with general statements rather than with the accounts of the particular experiments and observations on which those statements rest. Nor is there any serious attempt to ascertain the nature, character, and capabilities of this antennal language. Even if by motions of these organs Bees can caress, can express love, fear, anger, &c., it does not follow that they can narrate facts or describe localities.

* Introduction to Entomology, ii. p. 50.

† *L. c.* p. 206.

‡ *L. c.* p. 157.

§ *L. c.* p. 205.

Nor are the facts recorded by Kirby and Spence more explicit. It is therefore disappointing to read in the chapter especially devoted to this subject *, that, as regards the power possessed by Ants and Bees to communicate and receive information, "it is only necessary to refer you to the endless facts in proof, furnished by almost every page of my letters on the history of Ants and of the Hive Bee. I shall therefore but detain you for a moment with an additional anecdote or two, especially with one respecting the former tribe, which is valuable from the celebrity of the narrator."

The first of these anecdotes refers to a Beetle (*Ateuchus pilularius*), which having made for the reception of its eggs a pellet of dung too heavy for it to move "repaired to an adjoining heap and soon returned with three of his companions. All four now applied their united strength to the pellet and at length succeeded in pushing it out, which being done, the three assistant Beetles left the spot and returned to their own quarters." This observation rests on the authority of an anonymous German artist; and though we are assured that he was a "man of strict veracity," I am not aware that any similar fact has been recorded by any other observer.

The second case is related by Kalm, on the authority of Dr. Franklin; but it does not seem to me to justify the conclusions drawn from it by Messrs. Kirby and Spence. Dr. Franklin having found a number of Ants in a jar of treacle, shook them out and suspended the jar "by a string from the ceiling. By chance one Ant remained, which, after eating its fill, with some difficulty found its way up the string, and, thence reaching the ceiling, escaped by the wall to its nest. In less than half an hour a great company of Ants sallied out of their hole, climbed the ceiling, crept along the string into the pot and began to eat again; this they continued until the treacle was all consumed, one swarm running up the string while another passed down. It seems indisputable that the one Ant had in this instance conveyed news of the booty to his comrades, who would not otherwise have at once directed their steps in a body to the only accessible route" †.

As regards Wasps, Huber states that they are also acquainted with the mode of imparting information to their companions.

When a single Wasp discovers a strong-hold of sugar, honey,

* *L. c.* p. 422.

† *L. c.* p. 422.

or other article of food, it returns to its nest and brings off in a short time a hundred other Wasps; but we are yet ignorant if it be by visible or palpable signs they are mutually informed of this discovery”*.

A short but very interesting paper by Dujardin on this subject is contained in the ‘*Annales des Sciences*’ for 1852. He satisfied himself that some Bees which came to honey put out by him for the purpose “avaient dû recevoir dans la ruche un avertissement porté par quelques-unes de celles qui étaient venues isolément, soit à dessein, soit par hasard” †. That no doubt might remain, he tried the following experiment, which, he says, “me paraît tout-à-fait concluante”.

“Dans l’épaisseur d’un mur latéral, à 18 mètres de distance des ruches A et B, se trouve une niche pratiquée, suivant l’usage du pays, pour constater la mitoyenneté, et recouverte par un treillage et par une treille, et cachée par diverses plantes grimpanes. J’y introduisis, le 16 novembre, une soucoupe avec du sucre légèrement humecté; puis j’allai présenter une petite baguette enduite de sirop à une abeille sortant de la ruche A. Cette abeille s’étant cramponnée à la baguette pour sucer le sirop, je la transportai dans la niche sur le sucre, où elle resta cinq ou six minutes jusqu’à ce qu’elle se fut bien gorgée; elle commença alors à voler dans la niche, puis deçà et delà devant le treillage, la tête toujours tournée vers la niche, et enfin elle prit son vol vers la ruche, où elle rentra.

“Un quart d’heure se passa sans qu’il revînt une seule abeille à la niche; mais, à partir de cet instant, elles vinrent successivement au nombre de trente, explorant la localité, cherchant l’entrée de la niche qui avait dû leur être indiquée, et où l’odorat ne pouvait nullement les guider, et, à leur tour, vérifiant, avant de retourner à la ruche, les signes qui leur feraient retrouver cette précieuse localité ou qui leur permettraient de l’indiquer à d’autres. Tous les jours suivants les abeilles de la ruche A vinrent plus nombreuses à la niche où j’avais soin de renouveler le sucre humecté, et pas une seule de la ruche B n’eut le moindre soupçon de l’existence de ce trésor et ne vint voler de ce côté. Il était facile, en effet, de constater que les premières se dirigeaient exclusivement de la ruche à la niche, et réciproquement.”

* Huber’s *Natural History of Ants*, p. 374.

† *Ann. des Sci. Nat.* 1852, p. 233.

Considering the immense number of bees in a hive and the number of very young ones, it seems almost incredible that the bees of a hive should all be known to one another. Yet we are assured by some writers that it is so. Gelien, for instance, says, "Qu'une abeille tombe par accident, ou soit poussé par le vent dans une ruche qui n'est pas la sienne, elle est saisie et mise à mort à l'instant, comme suspecte de mauvais desseins"*.

Burmeister also, in his excellent 'Manual of Entomology,' says that "The power of communicating to their comrades what they purpose is peculiar to insects. Much has been talked of the so-called signs of recognition in bees, which is said to consist in recognizing their comrades of the same hive by means of peculiar signs. This sign serves to prevent any strange bee from intruding into the same hive without being immediately detected and killed. It, however, sometimes happens that several hives have the same signs, when their several members rob each other with impunity. In these cases the bees whose hive suffers most alter their signs, and then can immediately detect their enemy."†.

Huber mentions that some ants which he had kept in captivity having accidentally escaped, "met and recognized their former companions, fell to mutual caresses with their antennæ, took them up by their mandibles, and led them to their own nests; they came presently in a crowd to seek the fugitives under and about the artificial ant-hill, and even ventured to reach the bell-glass, where they effected a complete desertion by carrying away successively all the ants they found there. In a few days the *ruche* was depopulated. These ants *had remained four months without any communication*"‡. This statement has been very naturally copied by succeeding writers, and adopted without hesitation. See, for instance, Kirby and Spence's 'Introduction to Entomology,' vol. ii. p. 66, and Newport, 'Trans. of the Entomological Society of London,' vol. ii. p. 239.

Latreille also mentions that he once cut off the antennæ of an ant, and that one of its companions, "evidently pitying its sufferings, anointed the wounded part with a drop of transparent fluid from its mouth;" but the constant repetition of this statement in works on entomology indicates that other similar cases have not been met with. Messrs. Kirby and Spence, indeed, say that "whoever

* 'Le Conservateur des Abeilles,' p. 140.

† Burmeister's 'Entomology,' p. 502.

‡ Huber, p. 172.

attends to what is going forward in the neighbourhood of one of their nests, will be pleased to observe the readiness with which they seem disposed to assist each other in difficulties. When a burthen is too heavy for one, another will soon come to ease it of part of the weight; and if one is threatened with an attack, all hasten to the spot to join in repelling it”*.

These statements imply, on the part of bees, wasps, and ants, a great amount of intelligence. As I have already observed, however, the observations recorded do not seem to me in all cases to bear out the inferences that have been drawn from them. Moreover, when the conclusions are so important, we cannot be too sure of the facts; and however eminent, therefore, the authority may be, it is most desirable that the observations should be repeated.

Another question connected with these insects on which I was anxious to make some experiments was the use of the antennæ. That they are the means of communication there can be no doubt; but it is also the general opinion that they are, in addition, organs of sense. Whether, however, their functions are olfactory, or whether they serve as ears, is still a point on which entomologists are divided.

Our great entomologist Newport, in a paper specially devoted to the subject, says:—

“These facts, connected with the previous experiments, have convinced me that the antennæ in all insects are the auditory organs, whatever may be their peculiar structure—and that, however this is varied, it is appropriated to the perception and transmission of sound.”

Dr. Ormerod also, who was so careful an observer of our British wasps, was of opinion that “the proper function of the antennæ seems to be that of an instrument of communication in the social tribes, and of an organ of hearing in insects generally”‡.

“The majority of modern physiologists and entomologists agree in explaining the antennæ as organs of hearing, as we have already remarked. Kirby and Spence’s representation (whose names were inadvertently omitted to be mentioned there as the authorities for our opinions) conveys so much conviction that we may

* Vol. ii. p. 55.

† Newport, ‘On the Antennæ of Insects.’ Trans. Ent. Soc. vol. ii. p. 245.

‡ Natural History of Wasps, p. 73.

almost consider it settled, although we must at the same time admit that all the difficulties are not solved''*.

Dr. Braxton Hicks, also, and M. Lespès, who have specially studied the anatomical structure of antennæ, are of opinion that they are organs of hearing †.

The weight of authority, then, in favour of this view (comprising, as it does, Sulzer, Scarpa, Schneider, Borkhausen, Bonsdorf, Carus, Straus-Dürckheim, Oken, Burmeister, Kirby and Spence, Lespès, and Hicks) is very great. Nevertheless other eminent entomologists, as, for instance, Lyonet, Küster, Robineau-Desvoidy, Vogt, and Erichson, regard these organs as the seat of the sense of smell.

These are but a few of the many interesting questions which yet remain unsolved with reference to the social Hymenoptera. I present, therefore, the following observations to the Society with much diffidence; for I am well aware that they are but fragmentary. It will, however, be some months before I shall be able to prosecute them any further; and I trust that in some points they may be found not devoid of interest. I hope also that in consequence of bringing them before the Society I may receive some suggestions with reference to future inquiries.

Bees.

It will be observed that the current statements with reference to the language of social insects depend much on the fact that when one of them, either by accident or in the course of its rambles, has discovered a stock of food, in a very short time many others arrive to profit by the discovery. This, however, does not necessarily imply any power of describing localities. If the Bees or Ants merely follow their more fortunate comrade, the matter is simple enough; if, on the contrary, others are sent, the case becomes very different.

In order to test this, I proposed to keep honey in a given place for some time, in order to satisfy myself that it would not readily be found by the Bees, and then, after bringing a Bee to the honey, to watch whether it brought others, or sent them—the latter of course implying a much higher order of intelligence and power of communication.

I therefore placed some honey in a glass, close to an open

* Burmeister's 'Entomology,' p. 415.

† Transactions of the Linnean Society, vol. xxii. p. 395.

window in my sitting-room and watched it for sixty hours of sunshine, during which no bees came to it.

I then, at 10 o'clock in the month of June, went to my hives, and took a bee which was just starting out, brought it in my hand up to my room (a distance of somewhat less than 200 yards), and gave it some honey, which it sucked with evident enjoyment. After a few minutes it flew quietly away, but did not return; nor did any other bee make its appearance.

The following morning I repeated the same experiment. At 7.15 I brought up a bee, which sipped the honey with readiness, and after doing so for about five minutes flew away with no appearance of alarm or annoyance. It did not, however, return; nor did any other bee come to my honey.

On several other occasions I repeated the same experiments with a like result. Altogether I tried it more than twenty times; and I am satisfied that these bees cannot all have lost themselves or met with accidents. Indeed I never found bees to return if brought any considerable distance at once. By taking them, however, some twenty yards each time they came to the honey, I at length trained them to come to my room. On the whole, however, I found it more convenient to procure one of Marriott's observatory hives, both on account of its construction and also because I could have it in my room, and thus keep the bees more immediately under own eye. My room is square, with two windows on the south-west side, where the hive was placed, and one on the south-east. Besides the ordinary entrance from outside, the hive had a small postern door opening into the room; this door was provided with an alighting-board and closed by a plug; as a general rule the bees did not notice it much unless the passage was very full of them.

I then placed some honey on a table close to the hive, and from time to time fed certain bees on it. Those which had been fed soon got accustomed to come for the honey; but partly on account of my frequent absence from home, and partly from their difficulty in finding their way about, and their tendency to lose themselves, I never could keep any marked bee under observation for more than a few days.

Out of a number of similar observations I give the following in detail, as throwing some light on the power of communicating facts possessed by the bees; they will also illustrate the daily occupations of a working bee.

August 24. I opened the postern door at 6.45 and watched some marked bees till the middle of the day.

Bee no. 1.

- | | |
|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| 6.50. One came to the honey. She then flew to the window, but after buzzing about for some time returned to the hive. | |
| 7.21. Back to honey. | 7.23. Back to hive. |
| 7.26. " " | 7.30. Flew to window and then fell on the floor. I was afraid she would be trodden on, so at 7.45 I showed her the way to the hive. |
| 8.40. Back to honey. | 8.45. Back to hive. I now closed the postern door till 10.15. |
| 10.35. Back to honey. | 10.39. To hive. |
| 10.45. " " | and then to hive. |
| 12.35. " " | 12.37. To hive again. |

Bee no. 2.

- | | |
|------------------------------|----------------------------------|
| 7. 0. She came to the honey. | 7. 5. She went back to the hive. |
| 7.12. Back to the honey. | 7.22. " " |
| 7.24. " " | 7.30. " " |
| 7.42. " " | 7.46. " " |
| 7.52. " " | 7.57. " " |
| 8. 5. " " | 8. 9. " " |
| 8.15. " " | 8.20. " " |
| 8.26. " " | 8.30. " " |
| 8.40. " " | 8.44. " " |
| 8.55. " " | 9. 0. " " |

I then closed the door till 10.15 ; at 9.5, however, she came round to the honey through an open window, but could not find her way back, so I had to put her into the hive.

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|---------------------------|-----------------------------------|
| 10.15. Back to the honey. | 10.17. She went back to the hive. |
| 10.20. " " | 10.23. " " |
| 10.30. " " | 10.33. " " |
| 10.50. " " | 10.55. " " |
| 11. 1. " " | 11. 6. " " |
| 11.17. " " | 11.23. " " |
| 11.33. " " | ? |
| 11.45. " " | 11.50. " " |
| 12. 0. " " | 12. 3. " " |
| 12.10. " " | 12.15. " " |
| 12.24. " " | 12.30. " " |

12.37.	Back to the honey.	12.43.	She went back to the hive.
12.52.	„	12.56.	„

Bee no. 3.

Also on August 24.

10.16.	Came to honey.	10.19.	Returned to hive.
10.30.	„	10.34.	„
10.55.	„	10.57.	„
11. 2.	„	11. 5.	„
11.11.	„	11.15.	„
11.24.	„	11.27.	„
11.35.	„	11.37.	„
11.45.	„	11.47.	„
11.57.	„	?	„
12.13.	„	12.16.	„
12.26.	„	12.30.	„
12.36.	„	12.42.	„
12.56.	„	12.59.	„

The next day I timed this bee as follows:—

7.23.	Came to honey.	7.25.	Returned to hive.
7.35.	„	7.37.	„
7.44.	„	7.45.	„
8.10.	„	8.12.	„
8.53.	„	8.55.	„

(The door was then closed till 9.30.)

9.35.	„	9.40.	To window, and at 9.49 to hive.
10.	„	10. 5.	Returned to hive.
10.13.	„	10.15.	„
10.22.	„	10.26.	„
10.35.	„	10.40.	„
10.45.	„	10.48.	„
10.56.	„	?	„
11. 7.	„	11.12.	„
11.18.	„	11.20.	„
11.35.	„	11.37.	„
11.47.	„	11.51.	„
12. 2.	„	12. 6.	„
12.25.	„	12.29.	„
12.51.	„	12.54.	„

August 26. Opened the postern at 6.30.

6.46. The same bee as before			
	came to the honey.	6.47. Back to hive.	
6.58. She returned to the honey.		7. 0.	„
7.23.	„	7.25.	„
7.32.	„	7.35.	„
7.45.	„	7.48.	„
7.55.	„	7.59.	„
8. 4.	„	8. 7.	„
8.19.	„	8.22.	„
8.39.	„	8.43.	„

During these observations scarcely any unmarked bees came to the honey.

In these cases, the postern being small, and on one side, was not very easily found. If the honey had been in an open place, no doubt the sight of their companions feasting would have attracted other bees; but in this case the honey was rather out of sight, being behind the hive-entrance, and was moreover only accessible by the narrow and winding exit through the little postern door.

But however exposed the honey might be, I found similar results, unless the bees were visible to their fellows. Thus on the 2nd, 3rd, 4th, and 5th October two or three marked bees were paying regular visits to some honey in my sitting-room; but during the whole time very few unmarked bees came to the honey.

I will now give a few more cases which tend to show that bees which have found a supply of sweets do not tell their fellows of the discovery.

9.19. I brought a bee to some honey.		9.24. She returned to the hive.	
9.55. She came back to the honey.		10. 0.	„ „
10. 8.	„ „	10.10.	„ „
10.16.	„ „	10.19.	„ „
10.28.	„ „	10.30.	„ „
10.37.	„ „	10.40.	„ „
10.50.	„ „	10.53.	„ „
11. 0.	„ „	11. 4.	„ „
11.11.	„ „	11.15.	„ „
11.22.	„ „	11.27.	„ „
11.34.	„ „	11.37.	„ „
11.46.	„ „	11.50.	„ „
11.55.	„ „	12. 0.	„ „
12. 6.	„ „	12. 7.	„ „

12.40.	She came back to the honey.	12.46.	She returned to the hive.
12.54.	” ”	12.57.	” ”
1. 2.	” ”	1. 4.	” ”
	Flew about.		
1.15.	” ”	1.18.	” ”
1.23.	” ”	1.27.	” ”
1.34.	” ”	1.41.	” ”
1.54.	” ”	2. 0.	” ”

After which she did not return. During this time no other bee came to the honey.

Again on another occasion I watched several bees, which on my list of marked bees stood as Nos. 3, 4, 7, 8, 10 and 11.

9.45.	Bee No. 10 came.	9.50.	Went back to hive.
10. 0.	” 10 ”	10. 3.	”
10.18.	” 10 ”	10.21.	”
10.26.	” 11 ”	10.30.	”
10.30.	” 4 ”	10.35.	”
10.36.	” 7 ”	10.45.	”
10.46.	” 4 ”	10.52.	”
10.49.	” 7 ”	10.52.	”
11. 0.	” 7 ”	11. 9.	”
11. 5.	” 4 ”	11. 9.	”
11.11.	” 7 ”	11.16.	”
11.21.	” 7 ”	11.29.	”
11.22.	A strange bee came.		
11.26.	Bee No. 4 came.	11.31.	”
11.30.	” 7 ”	11.39.	”
”	” 10 ”	11.36.	”
11.40.	” 4 ”	11.45.	”
11.45.	” 7 ”	11.50.	”
11.47.	” 10 ”	11.59.	”
”	Another strange bee came.		
12. 1.	Bee No. 4 ”	12. 6.	”
12. 2.	” 7 ”	12. 8.	”
12. 3.	” 3 ”	12. 7.	”
12. 4.	” 10 ”	12. 7.	”
12.14.	” 7 ”	12.18.	”
12.17.	” 4 ”	12.21.	”
12.24.	” 7 ”	12.31.	”
12.30.	” 10 ”	12.33.	”
12.36.	” 7 ”	12.46.	”
12.37.	” 4 ”	12.44.	”
12.37.	” 10 ”	12.40.	”
12.45.	” 10 ”	12.49.	”
12.50.	” 7 ”	12.54.	”
12.50.	” 4 ”	12.54.	”
12.53.	” 10 ”	12.56.	”

12.57. Bee No. 7 came.	1. 0. Went back to hive.
12.57. " 4 "	1. 2. "
1. 0. " 10 "	? "
1. 2. " 7 "	1. 6. "
1. 9. " 4 "	1.12. "
1.10. " 8 "	1.16. "
1.10. " 7 "	1.16. "
1.16. " 4 "	1.19. "
1.17. " 5 "	1.21. "
1.20. " 7 "	1.24. "
1.20. " 8 "	1.25. "
1.21. " 4 "	1.24. "
1.23. " 5 "	1.27. "
1.29. " 4 "	
1.29. " 7 "	

After this I ceased recording in detail ; but the above shows that while the marked bees came regularly, only in two cases did any unmarked bees come to the honey.

In the above cases the honey was poured into saucers, but not weighed. In the following I used a wide-mouthed jar containing rather more than 1 lb. of honey.

1.44. Bee No. 5 came.	1.45. Went away.
1.54. " 5 "	1.58. "
2. 2. " 5 "	2. 5. "
2. 9. " 5 "	2.13. "
2. 9. " 1 "	2.15. "
2.18. " 5 "	2.20. "
2.19. " 1 "	2.21. "
2.28. " 1 "	2.31. "
2.37. " 1 "	2.41. "
2.32. " 5 "	2.40. "
3.49. " 5 "	2.51. "
2.52. " 1 "	2.55. "
3.10. A stranger came which I numbered as No. 14.	
3.11. Bee No. 1 came.	3.13. Went away.
3.19. " 5 "	3.22. "
3.20. " 1 "	3.23. "
3.19. " 14 "	3.23. "
3.30. " 5 "	3.32. "
3.31. " 14 "	3.33. "
3.37. " 1 "	3.40. "
3.38. " 5 "	3.42. "
3.38. " 14 "	3.41. "
3.47. " 5 "	3.49. "
3.46. " 14 "	3.51. "
3.54. " 14 "	3.56. "

} She was disturbed.

4.	Bee No. 1 came.	4. 3.	Went away.
4.	" 5 "	4. 3.	"
4. 5.	" 14 "	4.11.	"
4.10.	" 5 "	4.12.	"
4.15.	" 14 "	4.20.	"
4.22.	" 1 "	4.25.	"
4.24.	" 14 "	4.29.	"
4.26.	" 5 "	4.29.	"

During the whole of this time only one strange bee came, as recorded above.

In the following case I put out, besides 1 lb. of honey, also 4 oz. of honey spread over two plates.

12.15.	One of my marked bees came.	12.21.	She went.
12.26.	She returned.	12.31.	"
12.36.	"	12.44.	"
12.51.	"	12.57.	"
1. 4.	"	1.12.	"
1.15.	"	1.19.	"
1.25.	"	1.32.	"
1.38.	"	1.44.	"
1.49.	"	1.55.	"
2.	"	2. 7.	"
2.14.	"	2.19.	"
2.25.	"	2.33.	"
2.38.	"	2.44.	"
2.50.	"	2.58.	"
3. 5.	"	3.13.	"
3.20.	"	3.32.	"
3.39.	"	3.45.	"
3.52.	"	4.	"
4. 7.	"	4. 9.	"
4.15.	"	4.20.	"
4.27.	"	4.32.	"
4.43.	"	4.45.	"
4.50.	"	4.59.	"
5. 7.	"	5.13.	"
5.25.	"	5.31.	"
5.42.	"	5.48.	"
5.56.	"	6. 1.	"
6.14.			

She was dis-
[turbed.

During this time no other bee came to the honey.

Not satisfied with this, I procured a fine honeycomb weighing 12½ lbs, and brought to it one of my marked bees

at 2.40.		2.47. She went back to the hive.	
3. 4. She returned.	3.13.	„	„
3.27. „	3.37.	„	„
3.46. „	3.56.	„	„
4. 6. „	4.18.	„	„
4.26. „	4.44.	„	„
4.54. „	5.10.	„	„
5.18. „	5.26.	„	„
5.36. „	5.46.	„	„
5.54. „	6. 7.	„	„
6.16. „	6.27.	„	„
6.34. „	6.46.	„	„
6.51. „	7. 4.	„	„
7.14. „			

During the whole of which time only one strange bee came. In this case it will be observed that she remained longer at the honey than in the previous instances. The intervals during which she was away were as follows:—

1st visit	9	minutes,
2nd „	10	„
3rd „	8	„
4th „	10	„
5th „	8	„
6th „	10	„
7th „	8	„
8th „	9	„
9th „	7	„
10th „	5	„
11th „	10	„

It seems obvious, then, that the bees which had found the honey did not communicate their discovery to the others.

Though the bees came readily out through the little postern door of my observatory hive, they had much difficulty in finding their way back until they had done so several times. For instance, the following may be taken as a typical case:—

August 8th.

At 6.50 a bee came out through the little postern door. After she had fed, she evidently did not know her way home; so I put her back.

At 7.10 she came out again. I again fed her and put her back.

At 10.15 she came out a third time; and again I had to put her back.

At 10.55 she came out again, and still did not remember the door.

Though I was satisfied that she really wished to return, and was not voluntarily remaining outside, still, to make the matter clear, I turned her out of a side window into the garden, when she at once returned to the hive.

At 11.15 she came out again; and again I had to show her the way back.

At 11.20 she came out again; and again I had to show her the way back (this makes five times); when, however,

at 11.30 she came out again after feeding, she returned straight to the hive.

At 11.40 she came out, fed, and returned straight to the hive.

At 11.50 she came out, fed, and returned straight to the hive; she then stayed in for some time.

At 12.30 she came out again, but seemed to have forgotten the way back; after some time, however, she found the door and went in.

Again:—August 24 at 7.20 a bee came through the postern; I fed her; and though she was not frightened or disturbed, when she had finished her meal she flew to the window and had evidently lost her way; so at 8 o'clock I in pity put her back myself.

August 29. A bee came out to the honey at 10.10; at 10.12 she flew to the window and remained buzzing about till 11.12, when, being satisfied that she could not find her way, I put her in.

Nay, even those who seemed to know the postern, if taken near the other window, flew to it, and seemed to have lost themselves.

This cost me a great many bees. Those which got into my room by accident continually died on the floor near the window.

This is also well shown by the following experiments:—At 10.15 I put a bee into a bell-glass 18 inches long and with a mouth $6\frac{1}{2}$ inches wide, turning the closed end to the window; she buzzed about till 11.15, when, as there seemed no chance of her getting out, I put her back into the hive. Two flies, on the contrary, which I put in with her, got out at once. At 11.30 I put another bee and a fly into the same glass; the latter flew out at once. For half an hour the bee tried to get out at the closed end; I then turned the glass with its open end to the light, when she flew out at once. To make sure, I repeated the experiment once more, with the same result.

Some bees, however, have seemed to me more intelligent in this respect than others. A bee which I had fed several times and which had flown about in the room, found its way out of the glass in a quarter of an hour, and when put in a second time came out at once. Another bee, when I closed the postern door, used to come round to the honey through an open window.

Bees seem to me much less clever in finding things than I had expected. One day (April 14, 1872) when a number of them were very busy on some berberries, I put a saucer with some honey between two bunches of flowers; these were repeatedly visited, and were so close that there was hardly room for the saucer between them, yet from 9.30 to 3.30 not a single bee took any notice of the honey. At 3.30 I put some honey on one of the bunches of flowers, and it was eagerly sucked by the bees; two kept continually returning till past five in the evening.

One day when I came home in the afternoon I found that at least a hundred bees had got into my room through the postern and were on the window, yet not one was attracted by an open jar of honey which stood in a shady corner about 3 feet 6 inches from the window.

One day (29th April, 1872) I placed a saucer of honey close to some Forget-me-nots, on which bees were numerous and busy; yet from 10 A.M. till 6 only one bee went to the honey.

I put some honey in a hollow in the garden wall opposite the hives at 10.30 (this wall is about five feet high and four feet from the hives); yet the bees did not find it during the whole day.

On the 30th March, 1873, a fine sunshiny day, when the bees were very active, I placed a glass containing honey at 9 in the morning on the wall in front of the hives; but not a single bee went to the honey the whole day. On April 20 I tried the same experiment, with the same result.

September 19. At 9.30 I placed some honey in a glass about four feet from and just in front of the hive; but during the whole day not a bee observed it.

As it then occurred to me that it might be suggested that there was something about this honey which rendered it unattractive to the bees, on a following day I placed it again on the top of the wall for three hours, during which not a single bee came, and then moved it close to the alighting-board of the hive. It remained unnoticed for a quarter of an hour, when two bees observed it; and others soon followed in considerable numbers.

Some days, indeed, the bees did not seem to care about honey. Thus, September 19, I placed eleven bees one by one on some honey not far from the hive; they all fed well and returned quietly to the hive, but not one came back to the honey.

Indeed, under such circumstances, though the bees almost invariably fed with every appearance of enjoyment, comparatively few returned to the honey, even when it was not above 20 or 30 yards from the hive.

As regards time, the examples given above may be taken as fair illustrations; and on the whole it seems that, if honey is easily procurable and near the hive, a bee will on an average make about five excursions in the hour.

Sometimes, however, a bee will stay for hours inside the nest, even when the day is suitable and other bees are out; for instance, on the 24th August a marked bee remained in the hive all the morning.

Burmeister, in the passage already quoted (ante p. 115), says that bees have a sign which serves to prevent any strange bee from intruding into the hive without being immediately detected and killed. This seems to rest on a statement of Gélien, who believed that in each hive the bees had some common sign or pass-word. As evidence of this, he mentions * that one of his hives had been for some days robbed by the bees from another; "et je désespérais de conserver cet essaim, lorsqu'un jour, sur le soir, je le vis fort inquiet, fort agité, comme s'il eût perdu sa reine. Les abeilles couraient en tout sens sur le devant et le tablier de la ruche, se flairant, se tâtant mutuellement, comme si elles eussent voulu se dire quelque chose. C'était pour changer leur signe de reconnaissance, qu'elles changèrent en effet pendant la nuit. Toutes les pillardes qui revinrent le lendemain, furent arrêtées et tuées. Plusieurs échappèrent aux gardes vigilantes qui défendaient l'entrée, avertirent sans doute les autres du danger qu'elles avaient couru, et que l'on ne pouvait plus piller impunément. Aucune de celles qui voulurent recommencer leur déprédation, ne pénétra dans la ruche dont elles avaient fait leur proie, et qui prospéra merveilleusement."

Dujardin, however, has suggested another explanation of this case. He thinks that the behaviour of the bees indicated not a change of sign or password, but an alteration in the state of the

* Le Conservateur des Abeilles, p. 143.

queen in relation to the colony, which thus resumed its ordinary condition, and found itself in a position to repel the invaders. However this may be, the observation of Gélien, though curious and interesting, scarcely seems to bear out the conclusion he has drawn from it.

So far as my own observations go, though bees habitually know and return to their own hive, still, if placed on the alighting-board of another, they enter it without molestation. Thus:—

On May 4 I put a strange bee into a hive at 2 o'clock. She remained in till 2.20, when she came out, but entered again directly. I was away most of the afternoon, but returned at 5.30; at six she came out of the hive, but soon returned; and after that I saw no more of her.

May 12. A beautiful day, and the bees very active. I placed twelve marked bees on the alighting-board of a neighbouring hive. They all went in; but before evening ten had returned home.

May 13. Again put twelve marked bees on the alighting-board of another nest; eleven went in. The following day I found that seven had returned home; the other five I could not see.

May 17. Took a bee and, after feeding her and marking her white, put her to a hive next but one to her own at 4.18. She went in.

4.22. Came out and went in again.

4.29. Came out. I fed her and sent her back.

4.35. Came out. Took a little flight and came back. 4.45
went in, but returned. 4.52. Went in.

4.53. Came out. 4.56. „

4.57. „ 4.58. „

5. 1. „ , took another little flight, and returned. I
fed her again. 5.25. Went in again.

5.28. Came out again. 5.29. „

5.31. „ 5.33. „

5.36. „ 5.40. „

5.46. Shut her and the others in with a piece of note-paper.

6.36. One of the bees had eaten its way through. I opened the door; and several, including the white one, came out directly. Till 6.50 she kept on going in and out every minute or two. Hardly any bees were flying, only a few standing at the doors of most of the hives. At 7.20 she was still at the hive-door.

May 20. Between 6 and 7 I marked a bee and transferred her to another hive.

May 21. Watched from 7.30 to 8.9 in the morning without seeing her. At half past six went down again, directly saw and fed her. She was then in her new hive; but a few minutes after I observed her on the lighting-stage of her old hive; so I again fed her, and when she left my hand she returned to the new hive.

May 22. 8 o'clock. She was back in her old hive.

May 23. About 12.30 she was again in the new hive.

As far as my experience goes, bees which have stung and lost their sting always die; not, however, immediately. On August 25 a bee which had come several times to my honey was startled, flew to one of the windows, and had evidently lost her way. While I was putting her back, she stung me, and lost her sting in doing so. I put her in through the postern, and for twenty minutes she remained on the landing-stage; she then went into the hive, and after an hour returned to the honey. After this, however, I did not see her any more.

As regards the affection of bees for one another, it is no doubt true that when they have got any honey on them, they are always licked clean by the others; but I am satisfied that this is for the sake of the honey rather than of the bee. On the 27th of September, for instance, I tried with two bees: one had been drowned, the other was smeared with honey. The latter was soon licked clean; of the former they took no notice whatever. I have, moreover, repeatedly placed dead bees by honey on which live ones were feeding, but the latter never took the slightest notice of the corpses.

Dead bees are indeed usually carried out of the hive; but if one is placed on the alighting-stage, the others seem to take no notice of it, though it is soon pushed off by the movements of the others. I have even seen the bees sucking the juices of a dead pupa.

Light.—Though bees do not come out at night, they seem to be much affected by light. One evening I lit a small covered lamp to go down to the cellar. A bee which was out came to it, and, flying round and round like a moth, followed me the whole of the way there.

Colour.—I have also made a number of experiments with reference to colours, on which, however, I will not now dwell. I will only say that it seems clear that bees can distinguish colours. For

instance, on the 2nd of October I placed some honey on slips of glass resting on black, white, yellow, orange, green, blue, and red paper. A bee which was placed on the orange returned twenty times to that slip of glass, only once or twice visiting the others, though I moved the position and also the honey. The next morning again two or three bees paid twenty-one visits to the orange and yellow, and only four to all the other slips of glass. I then moved the glass, after which, out of thirty-two visits, twenty-two were to the orange and yellow. These and other experiments seemed to me to show a real disposition, which was also well marked in the case of wasps, towards the orange and yellow. That they can see blue, however, is indicated by the following experiment:—Oct. 6. I had ranged my colours in a line, with the blue at one end. It was a cold morning, and only one bee came. She had been several times the preceding day, generally to the honey which was on the blue paper. This day also she came to the blue; I moved the blue gradually along the line one stage every half hour, during which time she paid fifteen visits to the honey, in every case going to that which was on the blue paper.

Sound.—Aug. 29. The result of my experiments on the hearing of bees has surprised me very much. It is generally considered that to a certain extent the emotions of bees are expressed by the sounds they make *, which seems to imply that they possess the power of hearing. I do not by any means intend to deny that this is the case. Nevertheless I never found them take any notice of any noise which I made, even when it was close to them. I tried one of my bees with a violin. I made all the noise I could, but to my surprise she took no notice. I could not even see a twitch of the antennæ. The next day I tried the same with another bee, but could not see the slightest sign that she was conscious of the noise. On Aug. 31 I repeated the same experiment with another bee, with the same result. On the 12th and 13th of September I tried several bees with a dog-whistle and a shrill pipe; but they took no notice whatever, nor did a set of tuning-forks which I tried on a subsequent day have any more effect. These tuning-forks extended over three octaves, beginning with *a* below the ledger-line. I also tried with my voice, shouting &c. close to the head of a bee; but in spite of my utmost efforts, the

* See for instance Landois, Zeits. f. wiss. Zool. 1867, p. 184.

bees took no notice. I repeated these experiments at night when the bees were quiet; but no noise that I could make seemed to disturb them in the least.

Temper.—I found the temper of the bees very variable. Generally they allowed me to handle them without any sign of irritation; while at other times, without any reason which I could discover, they stung me sometimes several times in a day; they seemed the more prone to do so the hotter the weather.

Wasps.

Sept. 18. I had in my room a nest of Humble Bees, which I fed with honey. The honey was also visited by wasps. One evening I marked one of these wasps (No. 1) which visited this honey; she was a large female of *V. germanica*; her last visit to the honey that day was at 6.30.

The next morning she came for the first time at 7.25, and fed till 7.28, when she began flying about the room and even into the next; so I thought it well to put her out of the window, when she flew straight away to her nest. My room, as already mentioned, had windows on two sides; and the nest was in the direction of a closed window, so that the wasp had to go out of her way in going out through the open one.

At 7.45 she came back. I had moved the glass containing the honey about 2 yards; and though it stood conspicuously, the wasp seemed to have much difficulty in finding it. Again she flew to the window in the direction of her nest, and I had to put her out, which I did at 8.2.

At 8.15 she returned to the honey almost straight. 8.21, she flew again to the closed window, and apparently could not find her way; so at 8.35 I put her out again. It seems obvious from this that wasps have a sense of direction, and do not find their way merely by sight.

At 8.50 back to honey, and 8.54 again to wrong window; but finding it closed, she took two or three turns round the room, and then flew out through the open window.

At 9.24 back to the honey; and 9.27 away, first, however, paying a visit to the wrong window, but without alighting.

At 9.36. Back to the honey, and 9.39 away, but, as before, going first to wrong window. She was away therefore 9 minutes.

9.50.	”	”	9.53 away, this time straight.	”	11	”
10.	”	”	10. 7	”	11	”
10.19.	”	”	10.22	”	12	”
10.35.	”	”	10.39	”	13	”
10.47.	”	”	10.50	”	9	”
11. 4.	”	”	11. 7	”	14	”
11.21.	”	”	11.24	”	14	”
11.34.	”	”	11.37	”	10	”
11.49.	”	”	11.52	”	11	”
12. 3.	”	”	12. 5	”	11	”
12.13.	”	”	12.15 $\frac{1}{2}$	”	8	”
12.25.	”	”	12.28	”	10	”
12.39.	”	”	12.43	”	11	”
12.54.	”	”	12.57	”	11	”
1.15.	”	”	1.19	”	18	”
1.27.	”	”	1.30	”	8	”

Here for the first time another specimen came to the honey.

At 1.37. Back to the honey, and 1.39 away (was rather disturbed,

1.46.	”	”	1.49	”	as I tried to	Interval 7	”
1.54.	”	”	1.58	”	mark her).	”	5
2. 5.	”	”	2. 7	”	”	”	7
2.15.	”	”	2.19	”	”	”	8
2.27.*	”	”	2.32	”	”	”	8
2.39.	”	”	2.42	”	”	”	7
2.50.	”	”	2.54	”	”	”	8
3. 2.	”	”	3. 6	”	”	”	8
3.14.	”	”	3.17	”	”	”	8
3.26.	”	”	3.29	”	”	”	9
3.38.	”	”	3.42	”	”	”	9
3.50.	”	”	3.58	”	”	”	8
4. 7.	”	”	4.12	”	”	”	9
4.20.	”	”	4.23	”	”	”	8
4.32.	”	”	4.36	”	”	”	9
4.46.	”	”	4.49	”	”	”	10
5.	”	”	5. 3	”	”	”	11
5.13.	”	”	5.17	”	”	”	10
5.26.	”	”	5.30	”	”	”	9
5.40.	”	”	5.44	”	”	”	10
5.54.	”	”	5.59	”	”	”	10
6. 7.	”	”	6.11	”	”	”	8
6.20.	”	”	6.25	”	”	”	9

She did not come any more that day; but, as will be seen,

* She very often, however, throughout the day, in going away, flew to the other window first, and then, without alighting, returned to and went through the open one.

she had made forty-five visits to the honey in eleven hours. During the whole of this time no strange wasp, except the one above mentioned, came to this honey.

The following day, September 20th, this wasp made her appearance in my room at 6.55, when she flew straight to the honey.

At 6.55 came to the honey.	6.59 went away.	
7. 8	7.10	Absent 9 minutes.
7.18	7.22	8 "
7.30	7.32	8 "
7.41	7.45	9 "
7.53	7.56	8 "
8. 4	8. 7	8 "
8.15	8.18	8 "
8.27	8.30	9 "
8.38	8.41	8 "
8.50	8.53	9 "
9. 1	9. 4	8 "
9.12	9.15	8 "
9.22	9.25	7 "
9.34	9.36	9 "
9.46	9.51	10 "
10. 1	10. 3	10 "
10.13	10.18	10 "
10.28	10.30	10 "
10.38	10.42	8 "
10.53	10.56	11 "
11. 7	11.11	11 "
11.21	11.25	10 "
11.32	11.36	7 "

The wasp which came once yesterday returned and rather disturbed the first.

At 11.49 came to the honey.	11.50 went away.	13 "
11.57	12	7 "
12. 8	12.11	8 "

Here I was away for about two hours.

2.42 came to the honey.	2.46 went away.	
2.58	3. 2	Interval 12 minutes.
3.15	3.17	13 "
3.25	3.28	8 "

Here I was called away.

4.25 came to the honey.	4.28	
4.41	4.45	13 "
5.15	5.19	30 "
5.30	5.35	11 "
5.45	5.50	10 "
6. 2	6. 6	12 "
6.15	6.17	9 "

This was the last visit that day. She made therefore thirty-eight visits during the time she was watched, which was not quite eight hours. She was at work from 6.55 to 6.15; and assuming that she was occupied in the same manner during the three hours when she was not watched, as during the rest of the time, she would have made over fifty visits to the honey during the day.

Wishing, however to have a complete record of a day's work, I watched her the following day without intermission.

September 21. I began watching at ten minutes past six.

6.16. She came to the honey. 6.19. She went away.

6.29.	"	6.32.	"	An interval of 10 minutes.	
6.41.	"	6.44.	"	"	"
6.55.	"	7.	"	"	9 "
7.11.	"	7.15.	"	"	11 "
7.23.	"	7.26.	"	"	8 "
7.37.	"	7.42.	"	"	11 "
7.56.	"	8. 3.	"	"	14 "

Was disturbed and seemed rather troubled.

8.11. She came to the honey. 8.14. She went away. An interval of 8 minutes.

8.20.	"	8.24.	"	"	6 "
8.31.	"	8.34.	"	"	7 "
8.40.	"	8.42.	"	"	6 "
8.50.	"	8.52.	"	"	8 "
8.58.	"	9.	"	"	6 "
9. 8.	"	9.11.	"	"	8 "
9.18.	"	9.22.	"	"	7 "
9.30.	"	9.32.	"	"	8 "
9.39.	"	9.40.	"	"	7 "
9.50.	"	9.54.	"	"	10 "
10. 1.	"	10. 5.	"	"	7 "
10.14.	"	10.17.	"	"	9 "
10.25.	"	10.28.	"	"	8 "
10.37.	"	10.40.	"	"	9 "
10.47.	"	10.51.	"	"	7 "
11.	"	11. 6.	"	"	9 "
11.17.	"	11.20.	"	"	11 "
11.34.	"	11.37.	"	"	14 "
11.50.	"	11.53.	"	"	13 "
12. 5.	"	12. 8.	"	"	12 "
12.20.	"	12.24.	"	"	12 "
12.36.	"	12.40.	"	"	12 "
1. 8.	"	1.11.	"	"	28 "
1.26.	"	1.28.	"	"	15 "
1.40.	"	1.42.	"	"	12 "
1.57.	"	2. 2.	"	"	15 "

2.10.	She came to the honey.	2.13.	She went away.	An interval of	8	minutes.
2.25.	"	2.30.	"	"	12	"
2.45.	"	2.56.	"	"	15	"
She buzzed about at the other window for a few minutes, which made the interval longer than usual.						
3.13.	She came to the honey.	3.18.	She went away.	An interval of	17	minutes.
3.29.	"	3.31.	"	"	11	"
3.41.	"	3.45.	"	"	10	"
3.49.	"	3.52.	"	"	4	"
4. 2.	"	4. 6.	"	"	7	"
4.19.	"	4.22.	"	"	13	"
4.29.	"	4.33.	"	"	7	"
4.40.	"	4.44.	"	"	7	"
4.51.	"	4.53.	"	"	7	"
5. 4.	"	5. 6.	"	"	11	"
5.16.	"	5.20.	"	"	10	"
5.32.	"	5.35.	"	"	12	"
5.45.	"	5.50.	"	"	10	"

It will be seen that the intervals of her absence were remarkably regular. On one occasion, indeed, she was only away four minutes; but this time I think she had been disturbed and had not provided herself with a regular supply of food.

The number of visits was fifty-one in eleven hours and a half. I tried whether she would be in any way affected by a dead wasp, so I put one on the honey; but she took no notice whatever.

I observed with other wasps, that when the open window was not the shortest way to their nests, they had a great tendency to fly to that which was in the right direction, and to remain buzzing about there.

During the whole of this day, only four or five strange wasps came to the honey.

As regards the regularity of their visits, and the time occupied, other wasps which I observed agreed very closely with this one. For comparison, it may be worth while to give one or two other cases. I will commence with that of a worker, I believe *V. vulgaris*, observed on the 19th September.

- 10 A.M. I put her to the honey, she fed and then flew about the room and at last got into my bee-hive.
- 10.54. She came in again at the window. I again put her to the honey. She again flew all about the room.
- 11.41. She returned and this time came to the honey; but when she had fed again flew round and round the room, and

did not seem able to find her way out. I therefore put her out.

12.11. She returned, and the same thing happened again.

12.28. She came back to the honey. 12.31. Flew straight away.

12.45.

”

12.57.

”

1.10.

”

1.26.

”

1.29.

”

Interval

1.38.

”

1.41.

”

9 minutes.

1.50.

”

1.53.

”

9 ”

2. 3.

”

2. 6.

”

10 ”

2.12.

”

2.16.

”

6 ”

Was disturbed.

2.20.

”

2.25.

”

4 ”

2.40.

”

2.43.

”

15 ”

2.51.

”

2.54.

”

8 ”

3. 1.

”

3. 4.

”

7 ”

3.13.

”

3.16.

”

9 ”

3.25.

”

3.28.

”

9 ”

3.35.

”

3.38.

”

7 ”

3.46.

”

3.50.

”

8 ”

3.58.

”

4. 1.

”

8 ”

4 10.

”

4.14.

”

9 ”

4.23.

”

4.25.

”

9 ”

4.34.

”

4.38.

”

9 ”

4.46.

”

4.50.

”

8 ”

4.58.

”

5. 4.

”

8 ”

5.14.

”

Was disturbed and flew about.

8 ”

She did not return any more that evening, but made her appearance again at half-past six the next morning.

From twelve o'clock, when she had learnt her way, till five, she made twenty-five visits in five hours, or about five an hour, as in the previous cases.

It struck me as curious that on the following day this wasp seemed by no means so sure of her way, but over and over again went to the closed window.

I will give one other illustration:—

September 21. At 11.50 I fed a wasp.

11.56. She returned to honey.

11.57. Flew away.

12. 6. ” ”

12. 8. ” ”

1.25. ” ”

1.27. ” ”

1.37. ” ”

1.39. ” ”

1.57. ” ”

2. 0. ” ”

2.15.	She returned to honey.	2.17.	Flew away.
2.22.	" "	2.25.	" "
2.32.	" "	2.36.	" "
2.50.	" "	2.55.	" "
3. 2.	" "	3. 4.	" "
3.14.	" "	3.18.	" "
3.28.	" "	3.30.	" "
3.40.	" "	3.44.	" "
3.51.	" "	3.55.	" "
4. 4.	" "	4. 8.	" "
4.16.	" "	4.20.	" "
?	" "	4.31.	" "
4.37.	" "	4.41.	" "
4.46.	" "	4.48.	" "
4.57.	" "	5.	" "
5. 9.	" "	5.12.	" "
5.22.	" "	5.26.	" "
5.31.	" "	5.36.	" "

After the above facts we may, I think, well say "How doth the little busy *wasp*." Even Mr. Ormerod seems hardly to have done justice to his favourites. He is very severe on those wasps which "take up their quarters on the wrong sides of our window." "I have nothing" he continues * "to say on behalf of these wasps; they are a nuisance and a terror to all who have little children. They are mere stragglers, who have lost all feeling of good fellowship, have deserted their nest, and are leading a freebooter's life." Many of them, on the contrary, I am satisfied, are perfectly respectable wasps which have unfortunately lost their way.

My experiments, then, in opposition to the statements of Huber and Dujardin, seem to show that wasps and bees do not convey to one another information as to food which they may have discovered. No doubt, when one wasp has discovered and is visiting a supply of syrup, others are apt to come too; but I believe that they merely follow one another. If they communicated the fact, considerable numbers would at once make their appearance; but I have never found this to be the case. The frequent and regular visits which my wasps paid to the honey put out for them proves that it was very much to their taste; yet few others made their appearance. For instance, on the 19th September, as recorded above, only one wasp came of herself to the honey; this wasp returned on the 20th, but not one other. The 21st was a hot day, and there were many wasps

* Natural History of Wasps, p. 245.

about the house; my honey was regularly visited by the two marked wasps; but during the whole day only five others came to it.

September 22. Again only one strange wasp came up to one o'clock.

September 27. Only one strange wasp came.

October 2 and 3. These days were cold; a few marked bees and wasps came to my honey, but no strangers.

October 4. Two strangers.

October 6. Only one stranger.

On these days the honey was watched almost without intermission the whole day, and was more or less regularly visited by the marked bees and wasps.

These and other observations of the same tendency seem to show that, even if wasps have the power of informing one another when they discover a store of good food, at any rate they do not habitually do so.

On the whole, wasps seem to me more clever in finding their way than bees. I tried wasps with the glass mentioned on p. 124; but they had no difficulty in finding their way out.

Sounds.—My wasps, though courageous, were always on the alert, and easily startled. It was, for instance, much more difficult to paint them than the bees; nevertheless, though I tried them with a set of tuning-forks covering three octaves, with a shrill whistle, a pipe, a violin, and my own voice, making in each case the loudest and shrillest sounds in my power, I could see no symptoms in any case that they were conscious of the noise.

I made also a number of experiments with reference to colour, which have satisfied me that wasps, like bees, are capable of distinguishing colours. I am anxious, however, to repeat and extend these observations, and shall then hope to have the opportunity of laying them before the Society.

The following fact struck me as rather remarkable. The wasp already mentioned at the foot of p. 135 one day smeared her wings with syrup, so that she could not fly. When this happened to a bee, it was only necessary to carry her to the alighting-board, when she was soon cleaned by her comrades. But I did not know where this wasp's nest was, and therefore could not pursue a similar course with her. At first, then,

I was afraid that she was doomed. I thought, however, that I would wash her, fully expecting, indeed, to terrify her so much that she would not return again. I therefore caught her, put her in a bottle half full of water and shook her up well till the honey was washed off. I then transferred her to a dry bottle and put her in the sun. When she was dry I let her out, and she at once flew to her nest. To my surprise, in 13 minutes she returned as if nothing had happened, and continued her visits to the honey all the afternoon.

This experiment interested me so much that I repeated it with another marked wasp, this time, however, keeping the wasp in the water till she was quite motionless and insensible. When taken out of the water she soon recovered; I fed her; she went quietly away to her nest as usual, and returned after the usual absence. The next morning this wasp was the first to visit the honey.

I was not able to watch any of the above-mentioned wasps for more than a few days; but I kept a specimen of *Polistes gallica* for no less than ~~three~~ ^{nine} months.

I took her, with her nest, in the Pyrenees early in May. The nest consisted of about twenty cells, the majority of which contained an egg; but as yet no grubs had been hatched out, and, of course, my wasp was as yet alone in the world.

I had no difficulty in inducing her to feed on my hand; but at first she was shy and nervous. She kept her sting in constant readiness; and once or twice in the train, when the railway officials came for tickets, and I was compelled to hurry her back into her bottle, she stung me slightly—I think, however, entirely from fright.

Gradually she became quite used to me, and when I took her on my hand apparently expected to be fed. She even allowed me to stroke her without any appearance of fear, and for some months I never saw her sting.

When the cold weather came on she fell into a drowsy state, and I began to hope she would hibernate and survive the winter. I kept her in a dark place, but watched her carefully, and fed her if ever she seemed at all restless.

She came out occasionally, and seemed as well as usual till near the end of February, when one day I observed she had nearly lost the use of her antennæ, though the rest of the body was as usual. She would take no food. Next day I tried again to feed her; but the head seemed dead, though she could still move her

legs, wings, and abdomen. The following day I offered her food for the last time; but both head and thorax were dead or paralyzed; she could but wag her tail, a last token, as I could almost fancy, of gratitude and affection. As far as I could judge, her death was quite painless; and she now occupies a place in the British Museum.

Ants.

My experiments with ants have not been very successful; I may, however, just mention the following:—

On the 29th of December I took some red ants and placed them in a glass in my room. On the 4th of March following I put four of them back into their nest, but could not see any sign of joy on their part, or any evidence that they were recognized by their former companions. As, however, they soon went down into their nest and were out of sight, this observation was not very satisfactory. I therefore took some of the ants which had been left in the nest, and placed them in the glass. They joined the others, and crossed antennæ in the usual way; but I saw no special signs of satisfaction or recognition. For the sake of comparison, I put some other red ants with them, and I could observe no difference of behaviour.

On *Oniscigaster Wakefieldi*, the singular Insect from New Zealand, belonging to the Family Ephemeridæ; with Notes on its Aquatic Conditions. By ROBERT MCLACHLAN, F.L.S.

[Read March 19, 1874.]

(Plate V.)

At the Meeting of the British Association for the Advancement of Science held at Bradford in September of last year, I brought before the notice of Section D a very singular species of Ephemeridæ that I had just received from my friend C. M. Wakefield, Esq., of Christchurch, Canterbury Settlement, New Zealand, and which I proposed to name *Oniscigaster Wakefieldi*, the generic term being suggested by the formation of the terminal abdominal segments, they being provided on each side with wing-like corneous acute expansions strongly resembling a portion of an *Oniscus* or of some other Crustacean, and the true relationship of which,